(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 977 420 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.02.2000 Bulletin 2000/05

(51) Int Cl.7: H04N 1/00

(21) Application number: 99305873.4

(22) Date of filing: 23.07.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 31.07.1998 US 127654

(71) Applicant: Hewlett-Packard Company
Palo Alto, California 94304 (US)

(72) Inventor: Dowe, Julie T.
Fort Collins, Colorado 80525 (US)

(74) Representative: Jehan, Robert et al
Williams, Powell & Associates,
4 St Paul's Churchyard
London EC4M 8AY (GB)

(54) A method and apparatus for transforming an image into an electronic signal

(57) A reflective surface (120, 202, 302) is provided behind a document (100, 208, 308) to be scanned on an optical image scanner, copier, facsimile machine or similar device. Preferably, the reflective surface (120, 202, 302) has a reflectance less than 90% with a preferred reflectance range of 60% to 75%. this reflective surface (120, 202, 302) is substantially integral with the scanner, copier or facsimile lid (200, 300) surface and substantially reduces image bleed-through while resulting in an acceptable level of color shift and an acceptable loss of dynamic range relative to a white surface. In a second embodiment, the reflective surface (120, 202, 302) is interchangeable by the end user in order to optimize the reflectance of the reflective surface (120, 202, 302) for any given document (100, 208, 308) to be scanned, copied, or faxed.

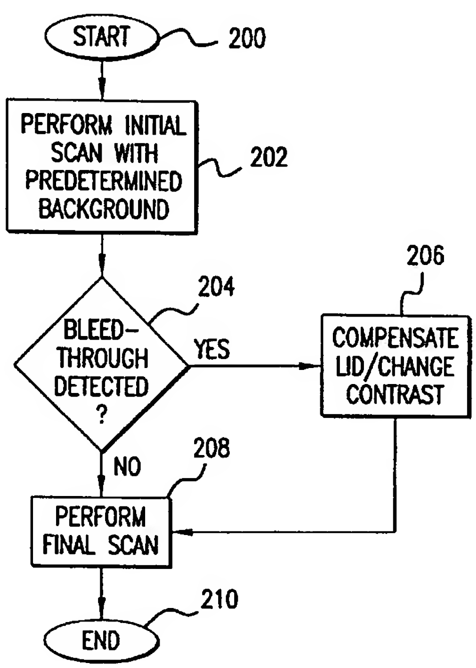

FIG.2

EP 0 977 420 A2

Description

[0001] This invention relates generally to scanners, copiers, facsimile machines and other devices used for transforming an optical image of a document into a electronic signal and for example to a reflective surface used behind a document to be imaged.

[0002] Electronic document scanners, copiers, and facsimile machines transform an optical image of a document into an electric signal suitable for storing, displaying, printing or electronic transmission. Documents to be scanned may generally be classified as either transparent or opaque. For opaque documents, light is reflected off an image on the surface of the document onto a photosensitive transducer, typically a photoconductive drum or an array of photosensitive sensor elements. However, documents are rarely completely opaque. In a typical device, some light passes through the document to a secondary reflective surface, for example a lid or automatic document feeder. Some light then reflects off the secondary reflective surface and passes back through the document a second time. The light that passes through the document twice may also be detected by the photosensitive transducer. If the document has an image on both sides, the image adjacent to the secondary reflective surface may be partially imaged onto the photosensitive transducer. For example, when copying double sided documents, sometimes an image on the back of the document partially appears in the resulting copy. This undesirable result is often called "bleed-through." There is a need for reduction of bleed-through in copiers, scanners, facsimile machines and similar devices.

[0003] The present invention seeks to provide an improved image.

[0004] According to an aspect of the present invention, there is provided a device for electronically transforming an image into an electronic signal as specified in claim 1.

[0005] According to another aspect of the present invention, there is provided an image processing device as specified in claim 4.

[0006] According to another aspect of the present invention there is provided an image processing device as specified in claim 6.

[0007] The preferred embodiment provides a document lid and secondary reflective surface which can minimize bleed-through and affects other image parameters of interest, such as brightness, contrast and color shift. The document lid and secondary reflective surface, which is the scanning or copying background, is dynamically variable and controlled to be either all white, all black, grey or some other color. The scanning or copying background can also be varied in different regions, such that the different regions can simultaneously be white, black, grey or some other color. The scanning or copying background may be directly controlled by the user or by a preview scan and software or firmware that adjusts the background to minimize the effects of bleed-through during the scanning/copying process.

[0008] An embodiment of the present invention is described below, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates a cross section of an embodiment of an imaging device cover including a secondary reflective surface;

Figure 2 shows a flow chart of a first embodiment of the processing method; and

Figure 3 shows a flow chart of a second embodiment of the processing method.

[0009] Figure 1 shows a document 100, laying face down on a transparent platen 102, with a lid or automatic document feeder 104 over the document 100. The document 100 has an image on a front face 110, and perhaps a second image on a back face 120. The lid or automatic document feeder 104 provides a dynamically variable background secondary reflective surface 114. A lamp 106 provides light rays 108. Most of the light rays 108 reflect off the front face 110 of the document 100, generating front reflected light rays 112. However, some of the light rays 108 pass through the document 100, reflect off of the dynamically variable background secondary reflective surface 114, passing through the second image on the back face 120 of the document, and back through the document 100, generating secondary reflected light rays 116. Both light rays 112 and 116 are received and transformed by a photosensitive transducer 118. Transducer 118 may be a photosensitive drum or an array of photosensitive elements or a single light beam may be scanned and reflected onto a single sensor.

[0010] Figure 1 is simplified in that scanning devices typically include lenses, mirrors and other optical components not relevant to the invention. It should be noted that Figure 1 may represent a copier, facsimile or scanner. In the interest of simplicity, a scanner will be described. However, the system also applies to copiers and facsimiles, to flat bed/stationary document machines or automatic document feeding machines.

[0011] The secondary reflective light rays 116 are of particular concern when scanning or copying color images, where accurate (as perceived by the human visual system) color reproduction is needed. For example, if the secondary reflective surface 114 were white, bleed-through would be evident with some pages that are printed on both sides, such as pages from magazines, which are often thin paper printed on both sides. If the secondary reflective surface 114 were black or non-reflective, this would eliminate the secondary reflected light rays and resulting bleed-through problem. However, a black background tends to darken the entire scan bed resulting in undesirable skin tones in photographs and dark overtones in white paper.

[0012] A black surface may create other undesirable

effects as follows. First, consider dynamic range (or contrast) of an image, which is the difference in reflectance between the darkest part of the image (sometimes called shadow) and the lightest part of the image (sometimes called highlight). Document 100 is typically paper. If light is permitted to reflect back through the light areas of an image, the light areas appear to be whiter, increasing the effective dynamic range. For an extreme example, consider an image on thin tissue paper. When viewed on a white background, the light areas of the image will appear white. When viewed on a black background, the light areas will shift toward gray, reducing the dynamic range of the image.

[0013] Second, a black background can cause a color shift. White paper typically acts as an optical filter, suppressing short wavelengths and passing long wavelengths. That is, white paper typically has a higher transmission for red and green wavelengths than for blue wavelengths. Again, using the extreme example of an image on thin tissue paper, when viewed on a white background, reds and greens appear relatively saturated and bright. When viewed on a black background, reds and greens appear less saturated. Subjectively, red tends to appear relatively dull or brick colored. Therefore, for both dynamic range and color shift reasons, a completely non-reflective surface 114 is not preferred.

[0014] Another option for a secondary reflective surface 114 is to use grey, which reduces the bleed-through problem without darkening the scan bed as much as black. However, the contrast of the scan bed is reduced, which may make it more difficult to automatically detect the presence of a document on the scan bed.

[0015] The Applicant has discovered that the optimal secondary reflective surface is dependent upon the specific item being scanned, copied or faxed. It would be optimal for software or firmware to adjust the background automatically based upon the item to be scanned, copied or faxed. Alternatively, the end user could change the color of the secondary reflective surface based on the document to be scanned, copied or faxed.

[0016] This may be accomplished in the preferred embodiment, in which the secondary reflective surface 114 has a dynamically variable reflectance, which may be controlled by the end user or operator of the scanner, copier of facsimile using buttons or some other form of input to indicate that a white, black, grey or color secondary reflective surface is to be used during the scan. Alternatively, software that determines the best color for the secondary reflective surface dependent on the item being scanned, copied or faxed may be included in the software or firmware that controls the copier, scanner or facsimile. The dynamically variable secondary reflective surface 114 may be an LCD screen, similar to the displays used in notebook computers The LCD screen may be placed over the document to be scanned in the same manner that a lid is placed over a document to be scanned.

[0017] There could be hardware controls for the end user or operator to change the screen color and also software controls. Software or firmware may be used to automatically search for bleed-through and color shift after a preview scan. The software or firmware could then change the screen color if necessary to reduce bleed-through, adjust the total dynamic range, or color shift problems after the preview scan is analyzed. The software could then initiate the actual scan of the document or perform another preview scan and readjust the screen color as necessary until the bleed-through, total dynamic range and color shift are within predetermined limits. The software may also adjust different portions of the dynamic background, so that different portions of the dynamic background or secondary reflective surface 114 are darkened or lightened where appropriate, such as when a magazine page with both text and photographs is being scanned.

[0018] Since the secondary reflective surface 114 is dynamically variable, it can be controlled to be all white, all black, all grey, or some other color. It can also have different regions that may be of different colors. That way, if there are variable items on the scanner, part of the secondary reflective surface 114 may be dark behind an item with bleed-through, and lighter behind a photograph with skin tones having color shift issues. If all items require bleed-through adjustment, the entire secondary reflective surface 114 may be black. If all items on a document are merely text on white paper, the background may be adjusted to white. Scanner software or firmware may automatically control the secondary reflective surface 114 by means of detection algorithms. The secondary reflective surface 114 could be manually controlled by an end user or operator for the appropriate background.

[0019] Alternatively, the secondary reflective surface 114 may be controlled by a combination of manual control and automatic software. For example, the end user may simply select a background for simple situations such as all text on white paper, OCR, photographs, or slides. And in the alternative, the end user may select a background and then select automatic adjustment, wherein the software may perform a preview scan with the initial background selected by the user and then make finer adjustments to the back ground in order to minimize bleed-through and color shift.

[0020] Figure 2 shows a flow chart in which an initial or preview scan is performed with a predetermined background color at 202. Software determines the bleed-through and color shift at 204. If the bleed-through and color shift were within predetermined limits, a final scan is performed 208. If the bleed-through or color shift was greater than the predetermined limits, the internal software changes the contrast or color of the secondary reflective surface 114 at 206 and then performs the final scan 208.

[0021] Figure 3 shows a flow chart of a second em-

bodiment in which an initial or preview scan is performed with a predetermined background color 302. Internal software determines the bleed-through and color shift 304. If the bleed-through and color shift were within predetermined limits, a final scan is performed 308. If the bleed-through or color shift was greater than the predetermined limits, the software or firmware changes the contrast or color of the secondary reflective surface 114. Then another preview scan is performed with the background at the newly adjusted color. The bleed-through and color shift are then recalculated 304 and if they are within predetermined limits, a final scan is performed 308. If the bleed-through and color shift are still not within predetermined limits, the secondary reflective surface 114 is adjusted again and another preview scan is performed. This loop is continued until the bleed-through and color shift are within the predetermined limits, at which time the final scan will be performed.

[0022] The foregoing description has been presented for purposes of illustration and description. For example, rather than being a flat bed scanner with the background secondary reflective surface 114 being an LCD screen the system could be incorporated into an automatic document feed scanner with the background secondary reflective surface 114 being a single line of LCDs. Also, rather than using an LCD screen as the dynamically variable secondary reflective surface 114, technology such as that used inside of windows to permit the window to be alternated between permitting light through and opaque with the flip of a switch may alternatively be used.

[0023] The disclosures in United States patent application no. 09/127,654, from which this application claims priority, and in the abstract accompanying this application are incorporated herein by reference.

Claims

1. A device for electronically transforming an image into an electronic signal, the image located at a first surface, the device comprising:

   an area operable to receive a document (100, 208, 308), the document (100, 208, 302) including a first image (110) on a first side and a second image (120) on a second side, the first image (110) located at the first surface;

   a reflective surface (114) adjacent the second side of the document (100, 208, 308) ; and

   the reflective surface (114) having a reflectance less than 90%, thereby reducing any electronic transformation of the second image (120) by the device when transforming the first image (110).

2. The device of claim 1, the reflective surface (114) having a reflectance less than 75 %.

3. The device of claim 2, the reflective surface (114) having a reflectance greater than 60% .

4. An image processing device for transforming an image into an electronic signal, said image processing device comprising:

   a surface (204) for supporting an original (208);

   a lid (200) for covering a rear side of the original (208) supported on the surface of said supporting surface (204), said lid (200) including a light reflecting surface (202), opposed to the supporting surface (204), said reflecting surface (202) being of the same material and integral with said lid (200);

   a light source for illuminating an original (208) supported on the support surface (204);

   a photodetector for producing an electric signal in response to light reflected by the original (208); and

   means for processing said electric signal produced by said photodetector.

5. The image processing device according to claim 4, wherein said reflective surface (202) has a reflectance not less than 60% and not more than 75%

6. An image processing device for transforming an image into an electronic signal, said image processing device comprising:

   a surface (304) for supporting an original document (308);

   a lid (300) for covering a rear side of the original document (308) supported on the surface (304) of said supporting member, said lid (300) including a light reflecting surface 302) opposed to the supporting surface (304), said reflecting surface (302) being of the same material as said lid (300), said light reflecting surface (302) being capable of being easily removed and replaced by a user of said image processing device, such that said user is able to interchange reflecting surfaces (302) of varying reflectance in said lid (300), so that the reflecting surface (302) may be changed to optimize the reflectance of the reflecting surface (302) for any original document (308) to be processed by said image processing device;

a light source for illuminating the original document (308) supported on the support surface (304);

photodetector for producing an electric signal in response to light reflected by the original document (308); and

means for processing said electric signal produced by said photodetector.

7. The image processing device according to claim 6, wherein said reflecting surface (302) and said lid (300) are made of plastics material.

8. The image processing device according to claim 7, wherein said reflecting surface (302) is capable of being snapped into said lid (300).

9. The image processing device according to claim 7, wherein said reflecting surface (302) is capable of being slid into and out of said lid (300).

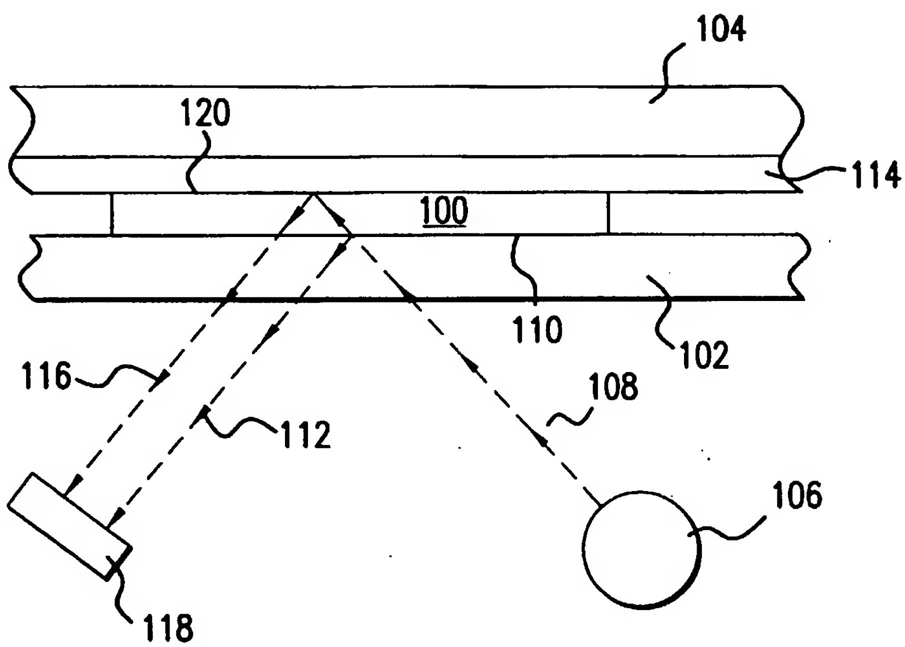

FIG.1

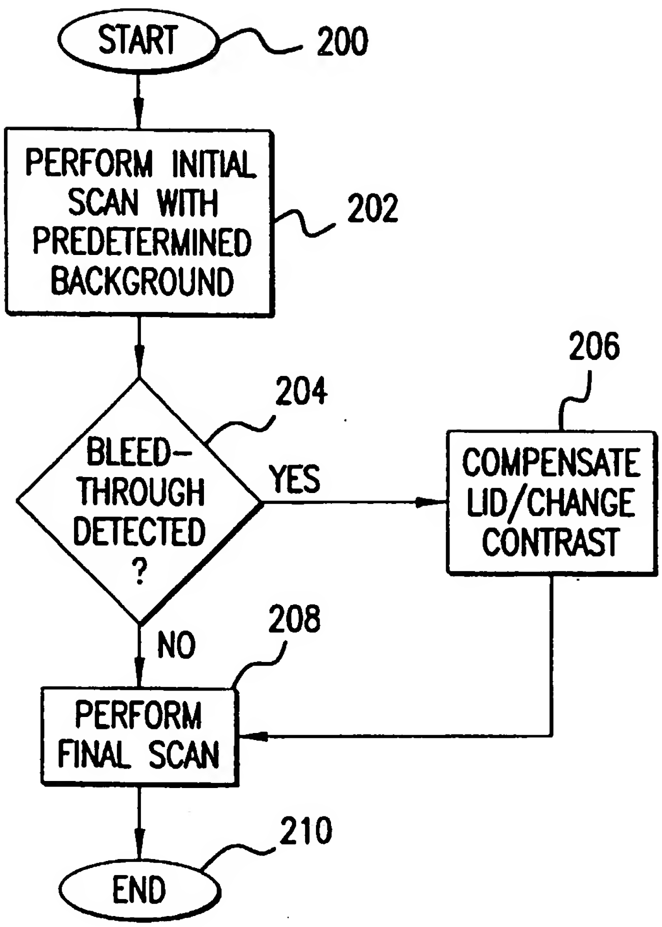
START
200
PERFORM INITIAL SCAN WITH PREDETERMINED BACKGROUND
202
206
204
BLEED-THROUGH DETECTED ?
YES
COMPENSATE LID/CHANGE CONTRAST
NO
208
PERFORM FINAL SCAN
210
END

FIG.2

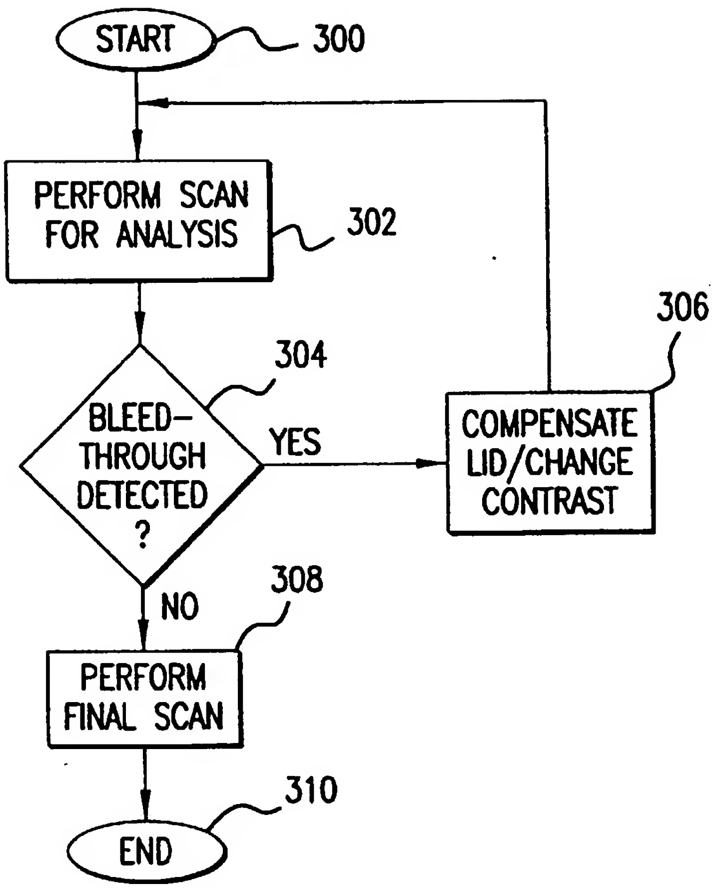
START
300
PERFORM SCAN FOR ANALYSIS
302
304
BLEED-THROUGH DETECTED ?
YES
NO
306
COMPENSATE LID/CHANGE CONTRAST
308
PERFORM FINAL SCAN
310
END

FIG.3

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 977 420 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
31.01.2001 Bulletin 2001/05

(51) Int Cl.7: H04N 1/00

(43) Date of publication A2:
02.02.2000 Bulletin 2000/05

(21) Application number: 99305873.4

(22) Date of filing: 23.07.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 31.07.1998 US 127654

(71) Applicant: Hewlett-Packard Company
Palo Alto, California 94304-1112 (US)

(72) Inventor: Dowe, Julie T.
Fort Collins, Colorado 80525 (US)

(74) Representative: Jehan, Robert et al
Williams, Powell & Associates,
4 St Paul's Churchyard
London EC4M 8AY (GB)

(54) A method and apparatus for transforming an image into an electronic signal

(57) A reflective surface (120, 202, 302) is provided behind a document (100, 208, 308) to be scanned on an optical image scanner, copier, facsimile machine or similar device. Preferably, the reflective surface (120, 202, 302) has a reflectance less than 90% with a preferred reflectance range of 60% to 75%. this reflective surface (120, 202, 302) is substantially integral with the scanner, copier or facsimile lid (200, 300) surface and substantially reduces image bleed-through while resulting in an acceptable level of color shift and an acceptable loss of dynamic range relative to a white surface. In a second embodiment, the reflective surface (120, 202, 302) is interchangeable by the end user in order to optimize the reflectance of the reflective surface (120, 202, 302) for any given document (100, 208, 308) to be scanned, copied, or faxed.

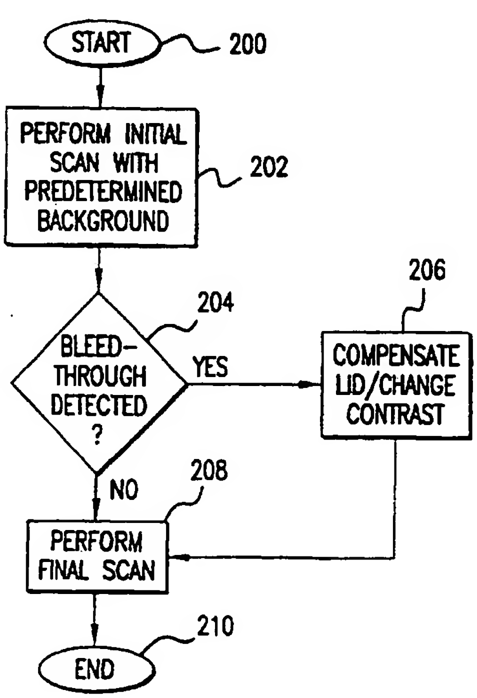

FIG.2

EP 0 977 420 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 30 5873

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 794 652 A (HEWLETT PACKARD CO) 10 September 1997 (1997-09-10) * the whole document * ---	1-9	H04N1/00
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 07, 31 March 1999 (1999-03-31) & JP 09 130554 A (XEROX CORP), 16 May 1997 (1997-05-16) * abstract *	1-9	
P,A	& US 5 790 211 A (SEACHMAN NED J ET AL) 4 August 1998 (1998-08-04) * column 2, line 20 - line 45 * -----	1-9	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
H04N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 December 2000	Hubeau, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 30 5873

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-12-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0794652 A	10-09-1997	JP 9244164 A	19-09-1997
JP 09130554 A	16-05-1997	US 5790211 A	04-08-1998

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82